Fly ash from Kazakhstan's coal fired-power stations: Characterization and utilization in wastewater purification

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Fly ash (FA) from two lignite-fed power stations in Kazakhstan has been characterized and utilized as raw material to synthesize zeolitic products with upgraded ion exchange capacity. Samples were collected from the electrostatic precipitators of two power stations (CHP) in Kazakhstan, located in Astana and Petropavlovsk (North Kazakhstan). Both stations are fed with sub-bituminous, high-ash coal from Ekibastuz open strip coal mine (North-Eastern Kazakhstan). Ash samples were characterized for their: a) major and trace element composition by means of Atomic Absorption Spectroscopy (AAS-F/GF), b) mineralogy by means of X-Ray Diffraction (XRD), c) porosimetric features by means of N_2-porosimetry, d) particle sixe distribution by laser-diffraction particle sizing, and e) microstructure by means of Scanning Electron Microscopy (SEM). Fly ash has subsequently undergone hydrothermal activation at escalated solid / liquid ratio (50, and 100 g FA / 1L NaOH) and constant temperature (90°C). The various zeolitic products developed were comparatively characterized by means of the same instrumentation. Various types of Na-zeolites have been identified as the predominant phases in the synthetic materials. Selected zeolitic samples were tested for their actual pollutant-removal capacity from artificial aquatic samples with known concentration of heavy metals (incl. As, Cd, Cr, Hg, and Zn) with up to 100% efficiency. It is noted that Kazakhstan is a major coal user and exporter and fly ash utilization in the country has not reached a mature stage yet. A full chemical/mineralogical mapping of the produced ash types is lacking as well. This study aims to lay the foundations for addressing both these challenges.

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